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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/509,553	05/17/2005	Manfred Ruehrig	1433.125.101/13.305	5911

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EXAMINER

STARK, JARRETT J

ART UNIT	PAPER NUMBER
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2823

DATE MAILED: 09/07/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/509,553

Applicant(s)

RUEHRIG ET AL.

Examiner

Jarrett J. Stark

Art Unit

2823

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 03 August 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 10-29 is/are pending in the application.
- 4a) Of the above claim(s) 18-29 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 10-17 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_.

- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_.

## DETAILED ACTION

### *Response to Arguments*

Applicant's arguments filed 8/3/2006 have been fully considered but they are not persuasive. The applicant argues that Anthony et al does not disclose that the two reference layers are antiferromagnetic coupled.

Anthony et al discloses in Col. 4 lines 20-48 & Fig. 4:

*FIG. 4 shows yet another embodiment of the magnetic memory cell 40 having symmetric switching characteristics according to the present teachings. In this embodiment, the magnetization of the reference layer 54 is pinned parallel to M3 by a layer 70 of antiferromagnetic material and the orientation of magnetization M1 in the reference layer 50 is set by antiferromagnetic coupling with a layer 74 of magnetic material through a spacer 80. The layer 74 has an orientation of magnetization M4 which is set by a layer 72 of antiferromagnetic material. The layer 74 may be a magnetic material such as cobalt-iron or nickel-iron. The antiferromagnetic coupling between the layer 50 and the layer 74 sets the desired orientation of M1 in the layer 50. The spacer 80 may be ruthenium between 4 and 10 angstroms thick. Materials such as Cr and Cu may also be used as the spacer 80.*

The antiferromagnetic layers 70 and 72 establish unidirectional anisotropy axes in layers 54 and 74 in a direction defined by  $M_4$ . Consequently, the layers 70 and 72 may be the same material such as iron-manganese, iridium-manganese, or nickel-manganese having the same blocking temperature. This embodiment does not require the heating and setting sequence for differing blocking temperatures as described above. The thickness of the layer 50 may be substantially equal to the thickness of the layer 54 plus the thickness of the layer 74 so that the demagnetization field from the layer 50 that affects the sense layer 52 balances the demagnetization fields from the layers 54 and 74 that affect the sense layer 52.

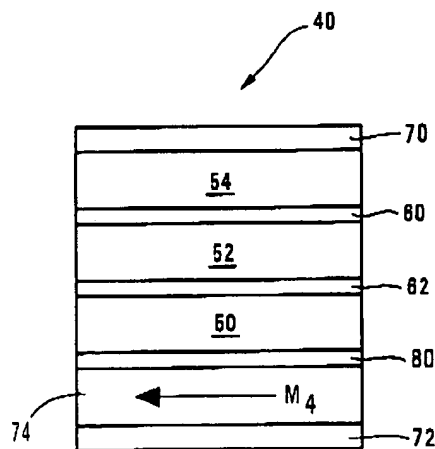


Figure 4

***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented<sup>3</sup> or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

**Claim 10** is rejected under 35 U.S.C. 102(b) as anticipated by Anthony et al. (US 6,172,904).

**Regarding claim 10**, Anthony et al. discloses a method for fabricating a reference layer for MRAM memory cells, comprising:

providing a layer system for the reference layer, the layer system having a first layer of a material having a first Curie temperature, wherein the first layer has a saturation field strength and can be permanently magnetized by an external magnetic field, and having a second layer of a material having a second Curie temperature, which is significantly lower than the first Curie temperature, wherein the second layer can be magnetized by antiferromagnetic coupling with the first layer; (Anthony, Col. 3 line 62 – Col. 4 line 5)

generating an external magnetic field having a field strength; (Anthony, Col. 4 lines 6 - 19)

cooling the layer system from a temperature above the first Curie temperature to below the first Curie temperature by action of the external magnetic field, the field

Art Unit: 2823

strength of the external magnetic field being greater than the saturation field strength of the first layer, so that magnetization of the first layer is oriented by a second-order phase transition along the field direction of the external magnetic field; and (Anthony, Col. 4 lines 6 - 19)

subsequently cooling the layer system below the second Curie temperature, magnetization of the second layer being oriented antiparallel with respect to the magnetization of the first layer on account of antiferromagnetic coupling between the first and second layers. (Anthony, Col. 3 line 49 – Col. 4 line 19)

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

**Claims 11-17 are** rejected under 35 U.S.C. 103(a) as being unpatentable over Anthony et al. (US 6,172,904).

**Regarding claim 11,** Anthony discloses the fabrication method of claim 10, further including setting the net magnetization of the layer system through the choice of

Art Unit: 2823

a saturation flux, in particular of the layer cross section in each case of the first and second layers. (Anthony, Col. 3 line 33-43)

It is inherent that the net magnetization of the layer is dependent of the composition of the material. The saturation flux is an obvious design choice that is notoriously well known. The ratios of the compositional material control the amount of net spin of the material which accounts for the net saturation flux. For an example please see additional reference Soft High Saturation Magnetization  $(\text{Fe}_{0.7}\text{Co}_{0.3})_{1-x}\text{N}_x$  Thin Films for Inductive Write Heads, by Sun et al.

It would have been obvious to one of ordinary skill in the art of making semiconductor devices to determine the workable or optimal value for the "saturation flux" through routine experimentation and optimization to obtain optimal or desired device performance because the "saturation flux" is a result-effective variable and there is no evidence indicating that it is critical or produces any unexpected results and it has been held that it is not inventive to discover the optimum or workable ranges of a result-effective variable within given prior art conditions by routine experimentation. See MPEP 2144.05

Given the teaching of the references, it would have been obvious to determine the optimum thickness, temperature as well as condition of delivery of the layers involved. See *In re Aller*, Lacey and Hall (10 USPQ 233-237) "It is not inventive to discover optimum or workable ranges by routine experimentation." Note that the specification contains no disclosure of either the critical nature of the claimed ranges or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen dimensions or upon another variable recited in a claim, the Applicant

Art Unit: 2823

must show that the chosen dimensions are critical. In re Woodruff, 919 f.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Any differences in the claimed invention and the prior art may be expected to result in some differences in properties. The issue is whether the properties differ to such an extent that the difference is really unexpected. In re Merck & Co., 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

Appellants have the burden of explaining the data in any declaration they proffer as evidence of non-obviousness. Ex parte Ishizaka, 24 USPQ2d 1621, 1624 (Bd. Pat. App. & Inter. 1992).

An Affidavit or declaration under 37 CFR 1.132 must compare the claimed subject matter with the closest prior art to be effective to rebut a prima facie case of obviousness. In re Burckel, 592 F.2d 1175, 201 USPQ 67 (CCPA 1979).

**Regarding claim 12,** Anthony discloses the fabrication method of claim 10, further including setting the net magnetization of the layer system to zero by the respectively identical net magnetization of the first layer and the second layer. (Anthony, Col. 3 line 3-22)

**Regarding claim 13,** Anthony discloses the fabrication of claim 10, further including setting the net magnetization of the layer system to be not equal to zero through selection of the second layer such that the layer cross section thereof is smaller than that of the first layer. (Anthony, Col. 3 line 3-22)

**Regarding claim 14,** Anthony discloses the fabrication of claim 10, wherein subsequently cooling the layer system below the second Curie temperature further



Art Unit: 2823

includes applying an external magnetic field, whose field direction is opposite to the magnetization direction of the first layer, upon passing through the second Curie temperature. (Anthony, Col. 3 line 49 – Col. 4 line 19)

**Regarding claim 15**, Anthony discloses the fabrication method of claim 10, wherein the layer system is further provided with a very thin intermediate coupling layer between the first and second layers, and wherein the antiferromagnetic coupling is imparted by the intermediate coupling layer. (Anthony, Col. 4 lines 32-35)

**Regarding claim 16**, Anthony discloses the fabrication method of claim 10, wherein the material of the first layer is chosen from a group comprising (Co,Fe,Mn).sub.80(Si,B).sub.20; (Co,Fe).sub.83(Si,B).sub.17; and Tb.sub.20Fe.sub.40Co.sub.40, and the material of the second layer is chosen from the group comprising (Co,Fe,Mo).sub.73(Si,B).sub.27; (Ni,Fe).sub.78(Si,B,C).sub.22; and Tb.sub.20Fe.sub.80. (Anthony, Col. 3 lines 35-43), (Anthony, Col. 3 lines 52-61)

**Regarding claim 17**, Anthony discloses the fabrication method of claim 15, wherein the material of the intermediate coupling layer is chosen from the group comprising ruthenium, copper, and gold. (Anthony, Col. 4 lines 32-35)

***Conclusion***

**THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jarrett J. Stark whose telephone number is (571) 272-6005. The examiner can normally be reached on Monday - Thursday 7:00AM - 5:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Smith can be reached on (571) 272-1907. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Art Unit: 2823

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

JJS  
August 25, 2006

  
MICHELLE ESTRADA  
PRIMARY EXAMINER